Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

AIC-56

MAINTAINING COTTON CONSUMPTION THROUGH INCREASED EFFICIENCY IN MANUFACTURE

by R. J. Cheatham [1]
Southern Regional Research Laboratory, New Orleans, Louisiana
Bureau of Agricultural and Industrial Chemistry
Agricultural Research Administration
U. S. Department of Agriculture

AUG 29 1944
U. S. DEPARTMENT OF AGRICULTURE

During the last three years, cotton has turned in probably the most remarkable performance of its entire history. Already the means of meeting 60 percent of this country's total textile requirements before the war, cotton was called upon more than any other fiber to clothe, equip, and supply our armed forces. As a result, domestic consumption of cotton climbed from a peacetime average of 6-1/2 million bales per year during 1935-39 to a peak of 11 million bales during each of the last two crop years. Although consumption during the crop year now ending is expected to total about 10 percent less than last year, it will still be far and away higher than during any peacetime year.

This remarkable achievement poses both a question and a challenge. Will consumption of cotton sink back to pre-war levels as soon as the war is over, or will it be possible for cotton to retain part of its gains? If we can absorb 10 or more million bales of cotton per year during the war, why can't we absorb that much during peace?

I don't think I need to dwell on what a 10-million-bale-a-year domestic consumption means in the way of prosperity to all segments of the cotton industry, nor do I need to emphasize the contributions it would make to full post-war employment and to a higher standard of living in the United States. I do want to point out just how much cotton is represented by 10 million bales. Ten million bales means an average of 37 pounds of cotton for every man, woman, and child in this country--as compared with a consumption of about 25 pounds per capita per year during the five years immediately preceding the war. In other words, to consume 10 million bales per year after the war, each of us must consume 12 more pounds of cotton a year. This 12 pounds would be just about enough to supply each of us with, say, two extra sheets, an extra tire, an extra pair of overalls, and three extra shirts or dresses, or equivalent products--surely not an unattainable goal.

Obviously post-war business conditions, post-war purchasing power, the status of our relationships with other foreign countries, and other general economic considerations will have much to do with determining how much cotton we can

---

[1] Presented before Fifth Annual Cotton Research Congress, held under the auspices of the Cotton Research Committee of Texas, at Dallas, Texas, July 13, 1944.

(over)

consume during the next few years. Despite the importance of these factors, I do not think we should sit back and assume that the future of cotton is inevitable and out of our power to control. By a positive program of action embracing all groups in the cotton industry, we can do much to assure prosperity for cotton after the war. It is my part of the program this afternoon to discuss what can be done by increasing manufacturing efficiency.

When we think of increasing manufacturing efficiency, we think primarily of lowering costs. If we can lower costs we can lower prices and bring more cotton products within the purchasing power of more people. At the same time we can strengthen the competitive standing of cotton products as compared to products of other industries.

The cotton textile industry has not been publicized as unusually progressive, but, nevertheless, it has been making tremendous strides during the past several years in the direction of increased efficiency. For instance, it now is spinning 40 percent more cotton on 30 percent fewer spindles than it did 15 years ago. In other words, it is processing 220 pounds of cotton per active spindle this year as compared with only 106 pounds per active spindle back in 1929. Progress in the industry has not been spectacular but, as I have indicated, there has been a steady upward trend in the output of the industry per unit of machinery.

With the end of the war, we can expect further marked gains in the efficiency of the cotton textile industry. Since the beginning of the war, the industry has been wearing out its equipment at an unprecedented rate. Unable to replace it for the present, it will be in the market for new machinery on possibly the largest scale in the history of the industry just as soon as the government permits it to be manufactured. Even with no further advances in textile manufacturing equipment, widespread additional installation of the latest model equipment will greatly increase the industry's efficiency. For instance, the latest model looms are reported to produce 40 percent more cloth per hour than an earlier model now in general use for weaving similar goods. Long-draft roving frames are now available that have in many instances replaced two or three of the old-type short-draft frames. Long-draft spinning is permitting the use of much coarser roving and consequently is making possible considerable reductions in the number of processes prior to spinning.

But of course the textile industry is not going to stop its progress when it has installed the latest available machinery. A steadily increasing amount of research on cotton manufacturing equipment and methods is going on all the time and new patents are issued almost every week for textile machinery and new processes. Let's discuss some of the advances that appear to be in the offing.

To begin with, scientific methods are becoming more and more important in the purchase of raw cotton. Mills are becoming increasingly interested in the variety of a cotton, where it grows, and how it tests in the laboratory for strength, length distribution, and other properties. Having a greater understanding of the raw material they are using, cotton mills will have fewer ends down and will be able to use, to a greater degree of precision, just the right quality of cotton to meet the specifications of the product they are making.

Over and above the recent development of one-process picking equipment, opening and cleaning equipment will be more efficient than it has been in the past, and will do a better job of opening and cleaning the cotton and delivering it in a uniform lap for further processing. In the next process, carding, there have been no particularly outstanding mechanical developments but considerable research is being performed with the object of increasing card speeds and increasing the uniformity of the sliver as it comes from this machine. I might mention, in passing, that interest in high-speed carding was accentuated when it was found that the carding process was a bottleneck preventing greater wartime production. With other processes preparatory to spinning, there is definite progress toward simplification, with the goal of using fewer machines and yet obtaining a more uniform product.

Proceeding now to spinning, we can expect still further increases in the output per unit of labor for this process, but no unusual additional increase in spindle speeds, at least in the near future. Although there is, as usual, talk of radically different spinning systems, and of such things as automatic doffing mechanisms that will drastically reduce labor costs for spinning, I don't think we should count too heavily on such developments in the immediate future.

Continuing finally to the weaving process, which generally accounts for 40 to 50 percent of total mill-processing costs, we find no basic mechanical changes during the last few years, but marked increases in the speed and efficiency of looms. No marked changes, but continuing steady progress can also be expected in the technology of weaving after the war.

I have mentioned only some of the changes that are taking place in cotton mills, but I might reiterate the recent statement of a prominent textile engineer that there will be increases of from 15 to 20 percent in the speeds of operations in the cotton textile industry. Throughout the cotton mill there will be a trend toward handling the material-in-process in larger unit quantities as a means of reducing labor costs. In fact, the rising costs of labor as compared with capital will be reflected by a greater degree of mechanization in the industry than heretofore. Another trend is toward greater use of air-conditioning for controlling not only the humidity but also the temperature and purity of the air in order to have the stock in the best possible condition for higher processing speeds. Advantage has already been taken and will continue to be taken in the textile industry of recent developments in the field of metallurgy and of such developments as the use 6f radiant energy for drying and the use of photoelectric cells for controlling the material-in-process.

(over)

There is still another development in the offing that I should like to discuss--a development called quality control. We have been doing quite a bit of thinking about this particular development at the Southern Regional Research Laboratory and we have now set up a project to study its possible applications in the textile industry. By quality control I mean the application of statistical methods that have been developed by mathematicians during the last few years to the study and control of fluctuations in the quality of a product. By its use, mills will be able to tell more precisely than before whether their product is just good enough to meet specifications, without being needlessly and expensively too good, and will be able to trace deficiencies more readily to their cause--whether it is poor cotton, poor carding, defective spindles, or other factors. Although quality control has already been applied in many industries it has had little application as yet in cotton manufacturing. We propose to study carefully in our laboratory the applications of quality control in the textile industry, hoping at the same time to add to our knowledge of what happens to cotton as it passes through the various processes.

In summarizing prospective improvements I might say that, although there seem to be no revolutionary changes immediately at hand in cotton manufacturing, steady progress is being made and it can be expected that the post-war manufacturing industry will be more efficient, by far, than it has been in the past. This may not mean that manufacturing margins will fall as low as they were during the depression years of 1932 and 1933, since it can be expected that earnings of textile workers, and taxes will continue at higher levels than before the war. It does mean that the output per worker will be higher and that the total cost per unit of output will be lower than at present.

While on this subject of costs, it might be well to bring up a matter that should not be overlooked. I refer to the fact that cotton is no longer the only fiber that can be processed on cotton mill machinery. Although cotton mills by tradition and experience are processors of cotton, they can now use rayon staple fiber also and are likely to do so if profits are greater. Rayon staple fiber of 1-1/2 inch staple is today selling at 25 cents per pound as compared with nearly 22 cents for middling 15/16 inch cotton. Although cotton is slightly lower in price, the price includes about 4.5 percent tare, as compared with no tare for rayon. Also, in processing cotton there is a loss of about 15 percent waste as compared with 4 or 5 percent in processing rayon, so that the actual difference in cost per pound is even less than the four cents indicated by the price quotations I have given. I am bringing up this point to emphasize the necessity of delivering cotton to the mill at a price that will be competitive with alternative materials. Any other steps that will increase the value of cotton delivered to the mill, such as improving its quality and its preparation, are also important from this standpoint.

Thus far, I have discussed mainly the progress being made by mills to increase their general manufacturing efficiency. Progress of this type is of great importance not only to mills but also to cotton growers and merchandisers, since it makes possible reductions in the prices that consumers pay for cotton goods. As I have already mentioned, such reductions bring more cotton goods into the purchasing power range of more people and also helps cotton in its competition with other materials. I should like to emphasize, however, that manufacturing costs are only one of the charges placed on cotton in its path from the cotton grower to the consumer, and even drastic reductions in mill costs may sometimes make only a small difference in the retail price of cotton products. For instance, if you could reduce the mill's cost margin for producing broadcloth by, say, 25 percent, it would make possible a reduction of only about 3 percent in the sales prices of cotton broadcloth shirts. On the other hand, there are other cotton products, such as bags, where cutting up and marketing charges are much less than for shirts and where a 25 percent cut in the cost of processing cotton into fabrics would mean a reduction of about 10 percent in the price to the consumer. Such a reduction might be more than sufficient to cause a swing to the use of cotton instead of burlap or paper for certain types of bags in this highly competitive field.

Regardless of the use to which cotton goods are put, even small savings in manufacturing costs may bulk large in the aggregate. For instance, a reduction of 1 cent per yard in the price of cotton goods might not seem large in our present era of inflated prices, but if it were made on every yard of the 10-1/2 billion yards of cotton cloth produced last year, it would mean an aggregate saving of 105 million dollars. These examples indicate, I believe, that, although even drastic reductions in manufacturing costs may make little difference in the sales price of some cotton goods, even small savings are very important for other cotton products, and result in huge aggregate savings to the nation.

Lowering of processing costs is not the only way in which the cotton textile industry can do its part in enabling cotton to meet today's challenge. Of equal or greater importance is efficiency in the development of new and improved cotton products--products that, although not necessarily lower in price, will give the consumer more for his money in durability, beauty, strength or whatever he wants, than he can obtain elsewhere. With the rapid progress being made by competitive materials, such as rayon and paper, adequate and sustained attention to the development of new and improved cotton products is absolutely essential if cotton is to hold its place. It is also, of course, a prerequisite to any program designed to increase the domestic market for cotton.

In the past the development of new cotton products was often, but not always, a haphazard business of guess and luck, too often carried out on the premise that the customer was lucky to get anything at all. But such a procedure has proved to be simply not good enough for our present highly competitive conditions. In its place we find an increasing use of scientific methods, and a marked rise in the number of research departments and research agencies in the cotton textile industry where the development of new products is undertaken on a systematic basis.

(over)

I don't suppose there is any simple formula for success in developing new cotton products, unless we say that like genius, it is a matter of one-tenth inspiration and nine-tenths perspiration. There are certain steps that can be taken, however, that have proved to be helpful in our experience.

First of all we need to have as thorough a knowledge as possible of the uses of cotton and competitive materials, both from a technological and an economic point of view. We, also, need to have a working knowledge of material requirements in other industries and of the developments that are taking place in them. Information of this type is often helpful in uncovering situations where a cotton product can be introduced or improved, and is important in deciding the particular problems that should be tackled first, since we cannot tackle all of them at once.

Having selected a particular problem on which to work, a second step might be the determination of physical, cost, and other requirements for the specific use under consideration and, also, the analysis of products now used to determine their suitability for the purpose. With the data thus obtained as a background, the next step would be that of actually designing the new or improved cotton product and manufacturing it experimentally. A scientific knowledge, as detailed as possible, of the properties of cotton and of how they can be manipulated by manufacturing processes to serve various purposes is, of course, essential at this stage. I should like, also, to stress the importance of being familiar with the latest advances in processing and finishing cotton goods, and with the latest fundamental scientific data regarding cotton, since single new developments often open the way for increased use of cotton in a whole series of applications. Having developed a new product, the final step would be testing it, first in the laboratory and later in actual use, to determine if it meets all the use requirements, and if not, to indicate where further work is needed.

We might call the above procedure the development of new and improved cotton products for specific uses. I should like to give you one or two examples of how such a procedure works out in actual practice.

Just before the beginning of the war, there was a shortage of burlap bags for packaging hairy vetch and Austrian winter peas, and it was found that customary types of cotten bags were not suited for the purpose. The cotton bags were not sturdy enough and were easily torn when probed with a seed trier to obtain samples, unlike the burlap bags in which the individual threads merely slipped away from the trier. Using these data as a background, we set about to develop an improved cotton bag for the purpose. A fabric construction consisting of a loose twill weave of fairly heavy yarns was specified since such a fabric would stand probing without tearing. At first, bags made of the new fabric were found to break out at the seams and at the sewed top, but this fault was later remedied when a new sewing technique, specially adapted to the new type of fabric, was developed. Bags thus made were found to be entirely satisfactory and replaced to a considerable extent the burlap and osnaburg bags previously used. More recently, however, one of the bag companies has developed a cotton bag that combines the advantages of our development with a lower cost. In this type of bag there is a "trier stripe" of a basket weave suitable for sample probing that is about 1-1/2 inches in width, while the remainder of the bag is of less-costly plain woven osnaburg. This type of bag is being used extensively at the present time for packaging products that must be sampled with a probe.

As another example, about 20 thousand bales of cotton are used annually in fish nets, fishlines, and other fishing gear. These products are damaged quite rapidly in use by the action of micro-organisms, and, although many chemical treatments have been tried as preservatives, none have proved to be entirely satisfactory. Recently, a resinous product has been employed as a preservative, using a unique method of application, with promising results. Tests made so far have shown that it is probably superior to all commercial preparations now used for this purpose.

In connection with the development of new and improved cotton products, I might stress again the importance of having a knowledge of the fundamental properties of cotton and of how they can be manipulated for various purposes. I should like to mention how a knowledge of one of these properties has been effective in developing improved cotton products.

When cotton yarn is made by ordinary manufacturing methods, it has a large percentage of what we might call stretchability--that is, it will stretch considerably when it is placed under tension. If, however, the yarn is once stretched under certain conditions, it will lose some of its stretchability and will not stretch as much thereafter under a given tension.

A good many years ago, one of America's great problems was the squeaking shoe. Research indicated that one of the causes of the squeaking was shoe thread that stretched and became loose when the shoe was in use. This led to the development and use of a low-stretch cotton thread that would hold more tightly in actual service, and that was made by subjecting the thread to a stretching process in its manufacture.

More recently, it came to our attention that the Post Office Department preferred jute twine, of which it uses a carload a week, to cotton twine for tying bundles of letters, since the jute twine stayed tight while the cotton twine would stretch and let bundles of letters fall apart. This problem also was solved by stretching the cotton twine during its manufacture so that it would stretch or give only slightly thereafter when in actual use.

As still another example, a few years ago, one of the problems of the tire industry was the way tires "grew" in service, with consequent weakening of the fabric-rubber structure. This tendency was traced back to the cotton cord, which gradually stretched, without again returning to its initial dimensions, under inflation pressures and flexing incident to tire service.

Here again, much of the problem was solved by subjecting the cord to a stretching treatment during its manufacture. Practically all cotton tire cord made today is given such a treatment.

I could cite many other examples of how properties of cotton have been manipulated to improve cotton products, but my time is short and I believe that the ones I have given will suffice to indicate the importance of scientific knowledge and of a methodical approach in developing new and improved cotton products. Since I have mentioned tire cord, I might digress for a moment to say that we are continuing to give more attention to development of an improved cotton tire cord than to any other project at the Southern Regional Laboratory. We are approaching the problem from every angle that gives any promise of success and by now are able to draw on the results of thousands of laboratory tests on experimental cords, as well as on the results of actual service tests, made possible by the cooperation of the War Department, the War Production Board, cotton tire-cord mills, and tire manufacturers. Although I cannot go into detail on the conclusions to be drawn from these results, I can say that we are thoroughly convinced that cotton is far from "down and out" insofar as tires are concerned.

Our experience in tire-cord research has again emphasized to us that for cotton to meet today's challenge, the combined and co-ordinated efforts of not only the cotton manufacturers, but also the cotton growers, the cotton ginners, and all others who handle cotton on its way to the final consumer, are essential. I have mentioned some of the ways in which the efficiency of cotton manufacture is being increased and have emphasized the importance of efficiency in developing new and improved products. Although 10 million bales of cotton is a large quantity, and, although the cotton industry is a huge one, its success hinges on how well it meets the needs of the individual consumer. If we can keep our attention focused on this all-important individual--not only giving him more for his money than he can obtain elsewhere, but also convincing him of it--I feel certain that we can meet today's challenge successfully.